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Planning the Standards Landscape: a framework for deliberate interoperability

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***ABSTRACT**: This paper presents the plan for establishing the SISO Standards Landscape. The Standards Landscape is to establish a framework that articulates the M&S standards that currently exist, relationships among the standards, user guidance on which standards best apply to different situations, where users can obtain the standards, and identifies areas where standards are needed but do not exist. The challenge is to develop an inter-view of standards that illustrates integrated standards within a meaningful framework of the Standards Landscape. The Standards Landscape portrays how standards work together to contribute to the interoperability and reuse to that enables organizations to achieve their return on investment (ROI) by increasing quality and productivity while reducing schedule and cost. This paper presents the plan to do just that. Further this paper describes how to apply quality attributes of the Standards Landscape to help communicate, through example, the need for a compelling and integrated view of standards.*

1. Introduction

The value of standards is return on investment (ROI) - There is a clear and sudden shift in attitudes towards software and modeling & simulation standards in particular. The climate of economic constraint and risk aversion along with the mandate to integrate systems on both sides of the enterprise has created a sea change in the sense of imperative to adopt standards. [1]

The EXCOM commissioned the SAC with the creation of a plan for producing the Standards Landscape. The specific action was to "Develop a framework that articulates the M&S standards that currently exist, relationships among the standards, user guidance on which standards best apply to different situations, where users can obtain the standards, and identifies areas where standards are needed but do not exist."

This paper presents how the plan or technical approach for developing the Standards Landscape was developed by following these seven steps:

1. Define Objectives
2. Perform Conceptual Analysis
3. Design the Standards Landscape
4. Plan to Develop the Standards Landscape
5. Plan to Integrate & Test the Standards Landscape
6. Plan to Execute the Standards Landscape
7. Plan to Assess the Standards Landscape

2. Technical Approach

2.1 Define Objectives

The objective for the plan is to develop a framework that articulates the portfolio of M&S standards that currently exist, relationships among those standards, user guidance on which standards best apply to different situations, where users can obtain the standards, and identifies areas where standards are needed but do not exist.

This objective was decomposed into problem/ consequence statements that were then analyzed to produce feature/benefit descriptions of the conceptual solution.

2.1.1 Problem/Consequence Statements

Problem/consequence statements were used to highlight the need for a standards landscape. These statements inform the reader on why the landscape is needed. They contrast with the feature/benefit statements of the framework that follow. Together the problem/ consequence and feature/benefit statements emphasize the impact of not addressing the problem, and the potential benefits that emerge when the problem has been addressed.

Problem Consequence – Return on Investment

SISO stakeholders need to apply standards to achieve their **return on investments** (ROI), but the learning curve is steep, there is no "one place to go" to find the information they need.

Problem Consequence – Miss-placed Competition

Competing standards within SISO is a distraction that prevents building upward and evolving standards to suit emergent stakeholder needs. This gives our stakeholders the wrong view of standards and implies a closed singular standard perspective to SISO's operation.

Problem Consequence – Body of Knowledge

The cumulative body of knowledge on the application of SISO standards is currently localized within groups and individuals. Stakeholders have no clear knowledge resource to answer questions or even to know the right questions to ask.

2.1.2 Feature/Benefit Statements

The feature/benefit statements provide insight into how the Standards Landscape addresses the problem/ consequence statements. One additional feature/benefit statement is included to focus the objectives in context to a specific set of stakeholders and associated needs.

Feature/Benefit – Enable a Clear Return on Investment Strategy for SISO Stakeholders

The Standards Landscape is not another cost saving initiative by itself. However an effective and understandable Standards Landscape saves costs of building, buying, supporting and maintaining multiple standards. It allows low priority, unnecessary or duplicate standards to be identified and removed from stakeholder architectures and systems. System development and maintenance become cheaper as solutions from across communities of interest can be identified and reused. In the standards environment some redundancy is necessary to support evolution of standards, however the Standards Landscape can help ensure that redundancy is planned not accidental, and that the investment in standards development can be optimized and improved across SISO. [1]

Feature/Benefit - Standards Alignment for Healthy Competition and Cooperation

The plan outlines how the Standards Landscape can help users compete and select standards during the early design phases of their environments/architectures. An effective Standards Landscape can inform these decisions. A user's selected set of standards then interoperate (cooperate) to bring integrity to their architectures. In this regard the Standards Landscape is a conceptual reference architecture, with each stakeholder's architecture being an instance architecture of the Standards Landscape.

Feature/Benefit – Online Body of Knowledge

The plan developed concepts to present stakeholders with multiple perspectives from which to view and understand the Standards Landscape. These views include:

- Layered diagram/framework of standards (static view) – Represents the taxonomy of standards, can be used to identify gaps in standards and/or standards alignment.
- M&S Life Cycle view of standards – Represents the recommended use or application of standards across the M&S life cycle.
- Network view of relationships – Represents the relationship of standards to COIs, SISO groups, significant events, etc.
- Timelines of events and product development milestones/activities – Represents a timeline view of significant events and the standards that apply to those events.

The intent of these views is to provide multiple "conceptual" viewpoints of the landscape to be developed for the multiple contexts of stakeholder perspectives to include:

- Managers
- Architects and Engineering Teams
- Software Engineers and Developers
- Standards Developers

2.2 Perform Conceptual Analysis

Conceptual analysis was used to describe how the features identified in the Define Objectives section of the plan can be used by stakeholders of the Standards Landscape on their projects and programs. This analysis focused on the System/Software Development Life Cycle shown in Figure 1. [2]

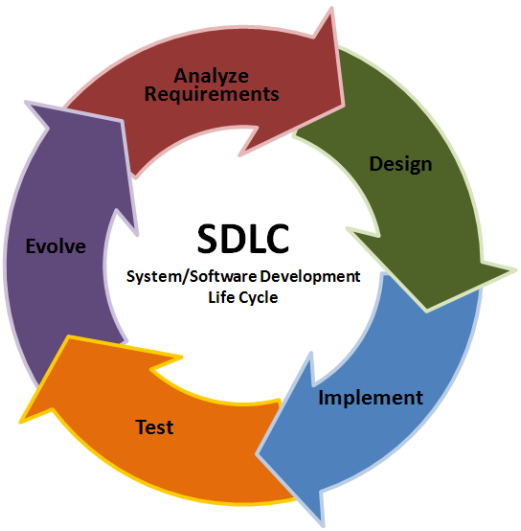

Figure 1. Conceptual System/Software Development Life Cycle

The analysis represents a use case approach to requirements development, where by use cases identify different ways a stakeholder could employ the framework to achieve their ROI through the informed application of SISO Standards.

2.2.1 Manager Use Cases

Manager use cases apply to stakeholders who lead architectural development projects for acquisition, budgeting, decisions for resource management. Ref DODAF 2.0 Volume 1. [3]

- Help managers understand the standards guidelines and products.
- Provide an appreciation of the potential level of effort involved in adopting standards within their architectures.
- Assist in discerning the potential uses/applications of standards within their architectures.

2.2.2 Architect Use Cases

Architect use cases apply to the architects and engineering teams who need to develop architecture products for high level decision makers (managers), for use in informing decisions, for use in defining a detailed product definition that is to be developed. Ref DODAF 2.0 Volume 2. [3]

- Enable the identification of standards to be included in a system/architecture based on the system's or architecture's intended use
- Determine needs and quality attributes.
- Analyze and relate the standards that apply.
- Compose standards into the architecture/system products.

2.2.3 Software Engineer and Developer Use Cases

Software engineer and developer use cases apply to members of engineering teams who need to conduct trade off analysis, develop components of products/systems, and integrate and reuse standardized components. Ref DODAF 2.0 Volume 3. [3]

- Identify reference implementations for standards.
- Verify compliance with a standard.
- Provide technical reference on the implementation of a standard.

2.2.4 Standards Developer Use Cases

Standards developer use cases apply to anyone who need to understand standards, alignment mechanisms between standards, relationships between standards, and gaps that exist in the standards landscape.

- Gaps in standards
- Needs for standards alignment
- Relationships to other standards organizations

These use cases apply to the SISO six-step process for evolving products from concept to standard, depicted in Figure 2.

Figure 2. SISO Six-Step Process [4]

IEEE-SA includes standards development life cycle detail on their web pages. There is an important difference between the two representations.

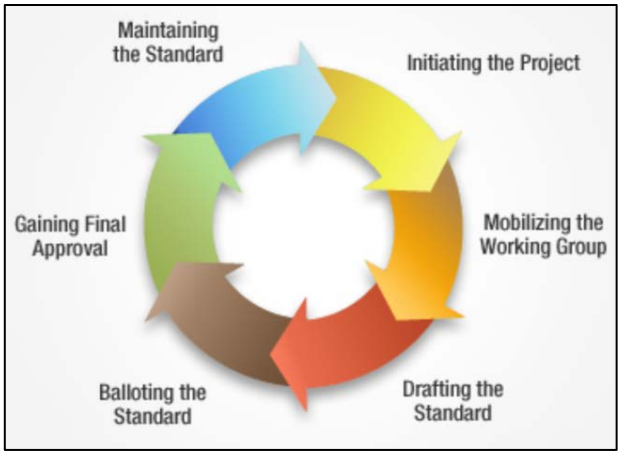

Figure 3. IEEE-SA Six-Step Process [5]

Illustrated in Figure 3, IEEE-SA reflects a closed loop six-step life cycle. Their life cycle view for standards development focuses less on the specific activities, and more on the benefits and qualities those activities bring. Both process views are accurate and important, but the IEEE view focuses on a stakeholder perspective external to IEEE as a standards development organization, while the SISO view focuses on a standards development perspective internal to SISO. The point of this comparison is that SISO may want to consider a simplified life cycle view that better reflects the qualities and benefits of SISO activities that serve to adapt and evolve standards as stakeholder needs change.

2.2.5 Use Case Analysis

Use cases are used to highlight qualities that are important to SISO stakeholders. The Standards Landscape data perspectives (views) are analyzed and refined based on the use cases identified.

The qualities identified in the plan represent stakeholder areas of concern that have the potential for broad impact across SISO communities of interest. Some of these qualities are related to the overall Standards Landscape design, while others relate to specific user-centric concerns. The extent to which the stakeholder information requirements are informed by the SISO Standards Landscape indicates the level of success to be expected in the implementation of the plan. Four views of the Standards Landscape were identified and evaluated to include:

- Taxonomy View
- Static Layered View
- Life Cycle View
- Network View
- Timeline View

The plan presents a taxonomy view representing a card catalog or registry approach for the Standards Landscape. The taxonomy view is the basic view from which stakeholders access SISO standards. The taxonomy of standards represents the metadata specifying the relationships that support the other views. In this regard the taxonomy view is the Standards Framework Taxonomy Knowledge Base (SFTKB) from which all other views are generated. Qualities to be developed through use case analysis include:

- Enable a person to find a standard by author, title, subject, category, etc.
- Provide a listing of standards in the SISO Standards Landscape.
- Assists in the choice of standards to employ for an organization, system, or architecture.

The plan presents a layered framework view of standards (static view) intended to document standards within a conceptual architecture. This view describes how standards interrelate (interoperate) through architectural layers and across roles/domains of the layers. Qualities developed for the plan through use case analysis include:

- The sources of data used to populate this view.
- The vertical layers to be included in the view.
- The horizontal domains and/or roles that apply across each layer of the view.
- The vertical linkage between roles of each layer.
- Identify gaps in standards across domains roles and vertical layers.

A SISO M&S Life Cycle view of standards based on DSEEP is presented in the plan. DSEEP was utilized in the plan to provide value by explicitly identifying the activities and tasks that must be performed to successfully develop and execute an M&S environment. The plan argues that because SISO develops simulation standards, it is reasonable to expect SISO standards to map to these existing DSEEP activities. This mapping identifies where each standard adds value in the overall M&S life cycle. This analysis can further identify DSEEP activities that could be done more efficiently and effectively if standards were available, but are not currently available. Qualities to be developed through use case analysis include:

- The sources of data used to populate this view.
- The determination of which standards apply to which phases of SISO's M&S life cycle.
- The identification of how standards interrelate, or are interdependent, across the M&S life cycle.
- The identification of gaps across DSEEP where standards could improve interoperability.

The plan presents a network view of relationships (COI, events, interdependencies, forums, best papers etc.). This view of standards relationships can communicate, by

example, successes stories of standards as well the standards development process. Qualities to be developed through use case analysis include:

- The sources of data used to populate this view.
- The knowledge of how standards apply to events, communities of interest, best papers, other standards, etc.
- The knowledge of what gaps still exist, which were identified in events, by communities of interest, by papers, etc.

The plan presents a timeline view of events and PDG efforts. This view is similar to the network view, except that the events are ordered in time. This view also includes the event context that interrelates standards; for example the events that led to MSDL and C-BML development being coordinated, or the first time MSDL was used in the DSEEP process by a particular COI.

- The sources of data used to populate this view.
- The knowledge of how events and communities of interest have been affected by standards over time.
- The knowledge of how standards have evolved over time to fill gaps and provide lessons learned.
- The understanding of the direction standards are evolving in, what next steps are to be taken in filling emerging gaps.

2.3 Design the Landscape

The design focuses on a concept of operation that satisfies stakeholder use case requirements. The Concept of Operation for the SISO Standards Landscape is to (1) provide the first impression of SISO standards to our stakeholders, (2) capture how SISO standards interrelate across SISO and non-SISO standards and communities of interest (COI).

The design is to specify the four "conceptual" views that will be integrate multiple contexts of SISO's Standards Landscape and associated content. These four views share common metadata on standards. The views vary in context depending on which relationships are represented and presented.

The NATO M&S Standards Profile (NMSSP) [6] analyzed standards from the contexts of (1) nine standards categories, and (2) architectural frameworks including the NATO Architectural Framework (NAF) [7]. One finding/ recommendation from that NMSSP includes:

"Standardization trends in the development of engineering processes dedicated to simulation is generally satisfactory considering current harmonization efforts taking place in SISO; nevertheless there is a need to integrate, in the emerging DSEEP, main concepts developed in Architecture Framework efforts which are currently too diverse." [6]

This plan attempts to close this gap between DSEEP and Architectural Frameworks by providing a road map for alignment of stakeholder architectures with the M&S Life Cycle.

2.3.1 Taxonomy View

Many standards organizations catalog standards by taxonomies. These include:

- International Organization for Standards (ISO) – Standards are cataloged by a hierarchy of fields as the domains for the international classification of standards (ICS) for example "Generalities." (http://www.iso.org/iso/ics6-en.pdf).
- The Institute of Electrical and Electronics Engineers Standards Association (IEEE-SA) – Standards are cataloged by a hierarchy of domain topic area, for example "aerospace electronics." (http://standards.ieee.org/findstds/index.html).
- The World Wide Web Consortium (W3C) – Standards are organized/sorted by multiple metrics of date, status, title, working/interest group, and author. Standards are further cataloged by W3C domain areas of Web Design and Applications, Web Architecture, Semantic Web, XML Technology, Web of Services, Web of Devices, Browsers and Authoring Tools. (http://www.w3.org/TR/).
- The Object Management Group (OMG) – Standards are cataloged by domains of the specifications (standards), for example "Business Modeling Specifications". OMG also includes categories for standards that apply from other standards organizations, such as ISO. Some domains are further broken down into sub-domains. (http://www.omg.org/spec/index.htm).
- The US National Institute of Standards and Technology (NIST) – Standards are cataloged by subject area domains, for example "bioscience and health." (http://www.nist.gov/index.html).

By contrast SISO catalogs products as separate listing of standards, references, and administrative products with limited groupings or hierarchy. Many of SISO's product/ study/support groups produce products in all three categories, yet those relationships are not deliberately represented by SISO except in free text. SISO can catalog standards by hierarchical categories that better reflect SISO's standards scope, and create cross references between those categories in specific context of those relationships (keywords, papers, events, COIs, domains & standards areas, etc.)

The Standards Landscape taxonomy view represents an information rich approach to the Standards Landscape. It can become the knowledgebase repository of metadata that supports other views to be provided by the Standards Landscape.

2.3.2 Layered Framework View

The layered framework view is an architectural reference for the SISO taxonomy of standards. This view communicates how standards align and interrelate.

- Horizontally aligned by roles and domains. For example by Live, Virtual Constructive; ACR, RDA, TEMO; other domains to be determined in the conduct of the effort.
- Vertically aligned by Operations, Systems, Data, and Ontology

The Layered Framework view is also a tool for identifying gaps in the Standards Landscape. It provides a context for investigating gaps by posing the right questions, for example "How do SISO standards provide for Control Mechanisms over Systems?", or "How does MSDL and C-BML align to a common Ontology?"

The intent of Layered Framework View is to provide an abstraction of how standards provide interoperability across layers of architecture, independent of any specific environment. Four general layers have been identified, for which standards provide for interoperability vertically through the layers to include:

- Operations
  - Control Mechanisms for Interoperability
- Systems
  - Data Interchange Mechanisms for Interoperability
- Data
  - Semantic Alignment for Interoperability
- Ontology
  - Shared/Common Environment for Interoperability

The needs of SISO stakeholders drive them to focus on the specific layers of the Standards Landscape that are applicable to their fields of expertise. SISO can support this focus by cataloging SISO standards by these layers.

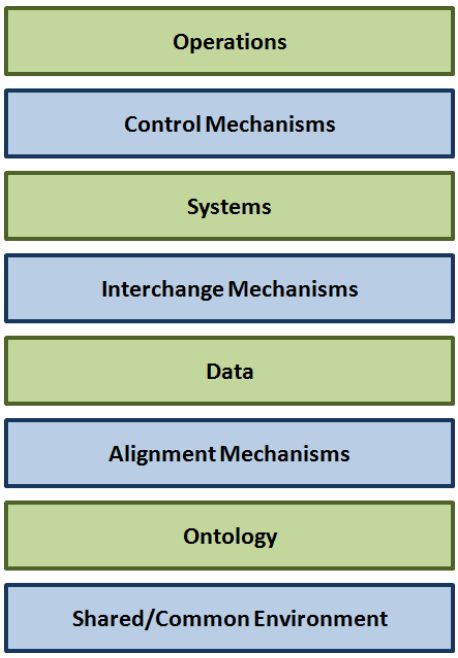

Figure 4. Layered Framework View

It is important to understand these relationships because understanding that alignment can help the framework speak directly to our stakeholders' perspectives. For example:

- Operations - Operational Manager/Commander
- Systems - System Developer/Integrator
- Data - Data Provider/Source
- Ontology - All of the Above

This alignment helps SISO understand which stakeholder use cases can to be analyzed in context to specific layers of the framework.

A second benefit it that this alignment can help SISO analyze the framework for gaps based on the areas of stakeholder and COI expertise that apply to each layer. For example the M&S COI includes:

- Data Management Working Group and its technical capability team, other working groups, and stakeholder forums.
- Operational Representation from the Military Services and Combatant Commands.
- M&S Developers and End Users.
- Data Producers, Data Consumers, and Data Integrators.
- Subject matter experts and participants from other DoD COIs, Government, Industry, Academia, and International Partners. [8]

SISO Standards can exist at any level/layer, but generally standards will align to the blue layers. For example:

DSEEP represents and standard process or operation for federation development.

DDCA represents a standard for control over replay for after action review.

CIGI represents a standard for image generator system APIs.

DIS, HLA, TENA represent standards for data interchange.

MSDL represents a standard for a data model.

Enumerations Working Group aligns SISO data standards.

JC3IEDM represents a standard for a common ontology.

SEDRIS represents a standard for shared synthetic environment data.

Figure 5. Examples of Standards by Layer

Exceptions include the common image generator interface (CIGI) and Dynamic Link Compatible HLA API Standard for the HLA Interface Specification, which best apply to the "Systems" layer. Standards in the green layers generally apply to commodity based products that are largely commercialized. For example the HLA API enables "federate developers to easily utilize RTIs provided by different vendors that support this objective." [4]

SISO can categorize standards by the domains they are used in. For example ISO maintains a catalogue of standards classified by their "International Classification of Standards" (ICS) code. Each code represents a domain of standards such as Electrical Engineering, Agriculture, Image Technology, etc. [11]

The horizontal roles to be represented can vary by domain. Roles do not constitute a fixed or necessarily finite list. The roles to be identified depend upon the life cycles, some domain specific, which will benefit from standards. Some examples include:

- DSEEP/FEDEP Life Cycle [9]
- Military Decision Making Process Life Cycle (MDMP) (http://www.fas.org/irp/doddir/army/fm5-0.pdf)
- The Acquisition Life Cycle Framework (https://dap.dau.mil/aphome/das/Pages/Default.aspx)

2.3.3 Life Cycle View

DSEEP - Seven step dynamic view of the M&S Life Cycle. This dynamic view is typically used to show how components of a system align across the life cycles. For DSEEP the life cycle phases are [9]:

1. Define Objectives
2. Perform Conceptual Analysis
3. Design Environment
4. Development Environment
5. Integrate & Test
6. Execute
7. Assess

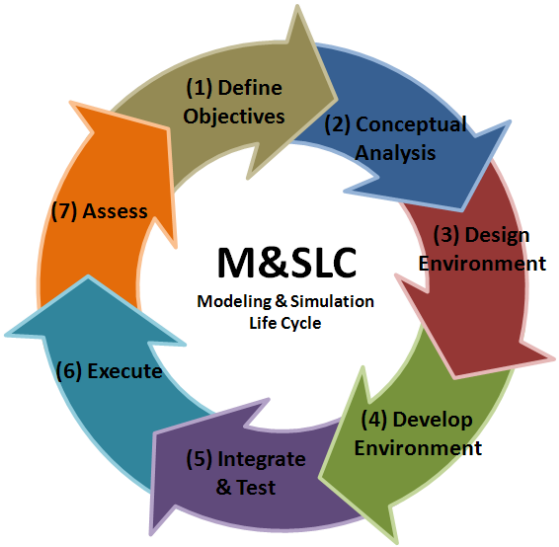

Figure 6. Modeling & Simulation Life Cycle

2.3.4 Network View(s)

Network views represent the relationships of standards to other standards, COIs, best papers, interoperability events/milestones, etc. The primary information being communicated is how standards interrelate.

The Standards Framework can provide networked relationship views of standards. The relationships of standards that can be represented include:

- Communities of interest, and their use case.
  - Product nominations include this information and will be mined for these relationships.
- Other standards categorized by:
  - International Organization for Standardization (ISO), http://www.iso.org
  - The Institute of Electrical and Electronics Engineers Standards Association (IEEE-SA)

- The World Wide Web Consortium (W3C)
- The Object Management Group (OMG)
- The US National Institute of Standards and Technology (NIST).
- Shared Public Specifications

- Best papers
  - Keywords from best papers (SIWzie awards) will be mined to reflect the relationships of papers to standards.
- Interoperability events/milestones of interest.
  - PDGs and PSGs will be used to document the schedule followed for balloting of their standards, and any events/milestones of interest such as NATO MSG events.
- Relationships to other SISO groups.
  - PDGs and PSGs will be used to document the interrelationships between PDGs as well as SSGs. For example MSDL PDG/PSG have strong relations with C-BML.
  - Earlier product nominations also included this information and will be mined for these relationships.

2.3.5 Timeline View

The timeline view represents the temporal order of events that led to interrelationships of standards. It provides the history of how standards evolved and the interrelationships emerged. This view is driven by the same metadata that drives the network view. However, instead of the relationship being the primary perspective, time/schedule is the perspective of the view.

- Standards development milestones.
- Significant interoperability events/milestones that relate one standard to COIs and other standards (different view of the networks). For example MSG events that link to their lessons learned, findings, conclusions, etc.
- Timeline view of best paper publications. For example paper 11F-SIW-020 documents the 14 best paper awards that provided for the technical development/readiness of C-BML as a standard. [10]

Timeline views provide a means of investigating threads of standards development and evolution. A stakeholder might begin by investigating the progression of Distributed Interactive Simulation (DIS), and then discover papers or events that dealt with high-level architecture (HLA) to DIS integration. From that timeline event the user can branch and investigate HLA sequels, etc. In this manner the timeline view compliments the network view much the same way the dynamic life cycle view complements the static layered view.

2.3.6 Data Collection

Data sources for the Standards Landscape include sources within SISO and sources outside of SISO. SISO data sources provide data that identifies relationships of standards to COIs, other standards, common reference models, and general knowledge about each standard. The data to be collected can be prioritized based on how the data supports the Standards Framework objectives (Return on Investment, Standards Alignment, Body of Knowledge, Inform Stakeholder Decisions).

Table 1. SISO Internal Data Sources

Source	Available Data
Product Nominations	Product nominations provide detail on relationships of standards to communities of interest, other standards, and problems the standard is intended to solve.
SISO Products	Standards products include detail that interrelates standards such as common terms and definitions, common reference models, specific interdependencies with other standards, etc.
SIWzie Papers	Identifies solutions/approaches from across communities of interest that can be reused by SISO stakeholders.
SISO Group Terms of Reference	SISO study, development, and support groups represent an information source for SISO's body of knowledge.
Existing Standards Landscape Documentation	Existing spreadsheet documents have captured some necessary relationships. However, spreadsheets are not adequate for capturing the breadth and depth of relationships.

External SISO data sources provide information on how standards are used/viewed by COIs, and how they relate to architectural framework in use by COIs. These communities have products/information that describes standards from their group's perspectives. The SISO standards framework will build upon these efforts by (1) reusing the knowledge they have captured, and (2) follow/implement recommendations from these communities to improve the standards landscape.

External SISO data sources provide information on how standards are used/viewed by COIs, and how they relate to architectural framework in use by COIs. These communities have products/information that describe standards from their respective perspectives. The SISO

standards framework will build upon these efforts by (1) reusing the knowledge they have captured, and (2) follow/ implement recommendations from these communities to improve the standards landscape.

Table 2. SISO External Data Sources

Source	Name & Web Site
AT&L	Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics (OUSD(AT&L)) (http://www.acq.osd.mil/index.html)
M&S CO	The Modeling & Simulation Coordination Office (M&S CO) (http://www.msco.mil/index.html)
NMSSP	The NATO Modeling & Simulation Standards Profile (NMSSP) [6].
AMSO	Army Modeling & Simulation Office (AMSO). (http://www.ms.army.mil/)
NMSO	Navy Modeling & Simulation Office (NMSO) (https://nmso.navy.mil/)
MCMSM	Marine Corps Modeling & Simulation Management (MCMSMO)
AFA&MS	Air Force Agency for Modeling & Simulation (http://www.afams.af.mil/)
M&SIAC	The Modeling & Simulation Information Analysis Center's (M&SIAC) (http://www.dod-msiac.org/)
ISO	International Organization for Standardization (ISO) (http://www.iso.org)
IEEE-SA	The Institute of Electrical and Electronics Engineers Standards Association (IEEE-SA). (http://standards.ieee.org/)
W3C	The World Wide Web Consortium (W3C) (http://www.w3c.org)
OMG	Object Management Group's (OMG) (http://www.omg.org/gettingstarted/gettingstartedindex.htm)
NIST	The US National Institute of Standards and Technology (NIST) (http://www.nist.gov/public_affairs/nandyou.cfm)
NGA	The US National Geospatial-Intelligence Agency (NGA). (https://www1.nga.mil/Pages/default.aspx)

These two tables can be integrated into the Standards Landscape to highlight "where users can obtain the standards" as required in the overall objective of the Standards Landscape.

The NATO M&S Standards Profile (NMSSP) provides a good starting point for aligning standards to DSEEP. "The NMSSP maintains information on M&S standards and recommended practices relevant to achieving M&S interoperability and reuse of M&S components, e.g. data, models. The NMSSP provides a set of standards descriptions for decision making on options for the use of M&S standards for NATO activities, e.g. coalition training and experimentation." [6]

The NATO M&S Standards Profile identified the problem of too many standards existing in one domain as:

> When there are too many "standards" in support of a particular domain it means "no real standard but many working technologies or methodologies". [6]

However, it should be noted that the number of standards alone does not necessarily indicate a problem within a standards development organization. For example:

> ISO has developed over 19,000 International Standards on a variety of subjects and more than 1000 new ISO standards are published every year. [11]

ISO confronts the problem in the number of standards by cataloging standards by domain and field. SISO can do the same in the development of the Standards Landscape. ISO took the additional step of creating cross references by fields (relationships) as well. When one field of a domain overlaps with another domain/field, those relationships are included as links or cross-references among the domains/fields.

W3C, IEEE-SA, and the NMSSP have all cataloged standards by subject or domain as well. The current set of subjects IEEE-SA uses includes:

- Application Areas
- Circuits and Devices
- Communication and Information
- Computer Engineering
- Control and Automation
- Earth/Ocean/Remote Sensing Electromagnetics
- General Interests
- Instrument/Measurement/Testing
- Interdisciplinary
- Nuclear and Plasma Science
- Optics and Optoelectronics
- Power and Energy
- Signal processing

The existing Standards Landscape spreadsheet documentation provides a starting point for interrelationships of SISO standards. Additionally, M&S CO as a partner of SISO has a document library with considerable data available for developing the SISO Standards Framework. Some examples include:

- Best Practices for the Development of Modeling and Simulations
- Study on Management Concepts for Broadly-Needed Modeling and Simulation Tools
- DoD M&S Body of Knowledge (BOK)

2.4 The Plan to Develop the Landscape

This plan builds upon the work already in place. First, the plan can start by emulating or adopting the approaches other standards organizations have used. Section 3.3 Design the Landscape provides references to IEEE, ISO, OMG, W3C, and NIST as instances from which SISO can adopt approaches for building the Standards Landscape.

Second, the plan is to evolve focus on the standards scope of SISO by integrating the work of SISO stakeholders and communities of interest. The NMSSP provides a good starting point from which to identify taxonomy categories, and alignment of standards to DSEEP. NMSSP catalogs standards by:

- M&S methodology, architecture and processes;
- Conceptual Modeling and Scenarios;
- M&S Interoperability;
- Information Exchange Data Models;
- Software Engineering;
- Representation of natural and human-made environment;
- Simulation Analysis and Evaluation;
- M&S Miscellaneous

The M&S CO standards crosswalk provides another good reference that identifies standards that apply to SISO stakeholders and communities of interest. The M&S CO has compiled a crosswalk that arguably provides the most concrete categories to be considered in developing the taxonomy to include:

- S-C-1: M&S Standards Management Process
- S-C-2: LVCAR Implementation & Net-centric Environment Implications
- S-C-3: Development and Maintenance of M&S Standards
- S-C-4: Develop Best Practices Guide for Contracting Models, Simulations & Associated Data
- I-C-1: Integrate DoD-wide M&S into Net-Centric Environment
- I-C-2: Rapid Data Generation (RDG)
- I-C-3: Enhancing Department Irregular Warfare Models & Simulations
- I-C-4: Environmental Data Cube Support System (EDCSS)
- V-C-1: Visibility of M&S Tools & Data
- V-C-2: VV&A Roadmap
- V-AQ-2: Risk Based Methodology for Verification, Validation & Accreditation (VV&A)
- M&S Core
- 009-FY11: Cyber Operations Research and Network Analysis (CORONA)

The data collection plan for the Standards Framework Taxonomy Knowledge Base is to identify the necessary data and data sources by analyzing the four views in context to stakeholder use cases identified in the Conceptual Analysis. This analysis is to include quantitative and qualitative analysis. The quantitative analysis is done in specific context of each use case. The qualitative analysis is based on identifying common attributes of quality that span stakeholder use cases. Once these quality attributes are identified, quality attribute scenarios—as abstract use cases—are developed. From these scenarios, the landscape team can derive additional quality based requirements used to develop and decompose the framework. These scenarios provide a means for weaving quality themes throughout the landscape in a consistent manner to provide overall conceptual integrity of the effort.

2.4.1 Quality Attributes

Quality attributes from Microsoft's "Microsoft Application Architecture Guide, 2nd Edition - October 2009" [13] and the Scientific Engineering Institute's text on "Software Architectures in Practice" [14] were analyzed based on the stakeholder use cases previously identified. Because the standards framework is to inform stakeholders on the development of their own architectures and simulation environments, quality attributes related to design time and run-time qualities were selected to include:

a. **Interoperability** - Interoperability is the ability of a system or different systems to operate successfully by communicating and exchanging information with other external systems written and run by external parties. An interoperable system makes it easier to exchange and reuse information internally as well as externally.

b. **Reusability** - Reusability defines the capability for standards and systems to be suitable for use in a variety of applications and across scenarios. Reusability increases productivity, shortens schedule, and increases quality.

c. **Conceptual Integrity** - Conceptual integrity defines the consistency and coherence of the overall design. This includes the way that

standards are designed, as well as factors such as documentation style and common terms and definitions, etc.

d. **Maintainability** - Maintainability is the ability of the framework to undergo changes with a degree of ease. These changes could impact standards, processes, and interfaces when adding or changing the standards, resolving problems, and meeting new business requirements (filling gaps).

The NMSSP also employs quality attributes of [1]:

a. **Relevance**: a standard shall be relevant to the targeted user/developer community;

b. **Substantive content**: a standard shall provide meaningful information and/or results;

c. **Timely production**, in an efficient manner, to ensure that the product is useful to the community;

d. **Reviewed** by the technical community to which the product applies and large acceptance;

e. **Generality**: standards should be as general as possible, while still maintaining usefulness, to support the broadest community of current and future users;

f. **Stability**: standards should be established and changed only as necessary. They should be prototyped and tested before being proposed for adoption to demonstrate their maturity;

g. **Supportability**: Standards should maintain the integrity of the existing product suite and the needs of the user.

Quality attributes are used to represent threads of discussion, like subplots of a story. They make the Standards Landscape compelling and meaningful in specific context to our stakeholders' quality attributes. It is worth noting the SISO uses quality attributes or "Product Principles" in documenting SISO standards. Those attributes include:

a. **Generality** - Standards Products shall be as general as possible, while still maintaining usefulness, to support the broadest community of current and future users. [4]

b. **Stability** – Standards Products shall be established and changed only as necessary. They shall be prototyped and tested before being proposed for adoption to demonstrate their maturity. [4]

c. **Supportability** – Standards Products shall maintain the integrity of the existing product suite and the needs of the user. [4]

SISO's current quality attributes are currently focused on qualities of individual standards products, but they can be expanded based on NATO and M&S CO qualities and applied to the Standards Landscape as a means of interrelating and aligning standards by focusing the landscape on a generalized set of views, which are stable, and easily supported.

2.4.2 Quality Attribute Scenarios

A Use Case or Operational Scenario driven approach would be applicable as we consider the framework from a stakeholder's point of view. The scenarios can be written by posing a question the scenario is to answer relative to each quality attribute:

a. "How do systems intercommunicate?" – Interoperability

b. "What would I use this [standard] for?" – Reusability

c. "How might I use these standards together?" – Conceptual Integrity

d. "How stable/extensible is the framework over time?" – Maintainability

"Software Architectures in Practice" [14] provides guidance for specifying quality attribute scenarios. These scenarios are developed based on a contextual template as shown in Figure 7. Quality Attribute Scenarios [14].

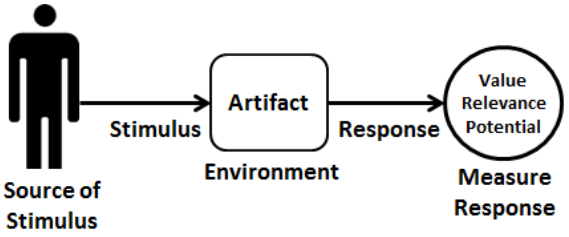

Figure 7. Quality Attribute Scenarios [14]

Quality attribute scenarios are used to develop and specify quality attribute specific requirements.

- Source of Stimulus – Entity/actor that generated the stimulus.
- Stimulus – The condition that needs to be considered for the system.
- Environment – Stimulus occurs within certain conditions.
- Artifact – Some artifact is stimulated.
- Response – The response to the activity initiated by the stimulus.
- Response Measure – Response should be measurable in order for requirements to be verified.

Much of the information needed can be data mined from data sources annotated in the Section 2.5.6 Data

Collection of the paper such as NATO/M&S CO reports, Product Nominations, specifications and guidelines.

These quality attribute scenarios are not necessarily part of the framework, but are used to decompose approaches to how standards are presented in context to the framework. They serve to ensure the architecture of the Standards Landscape supports the SISO business cycle. [14]

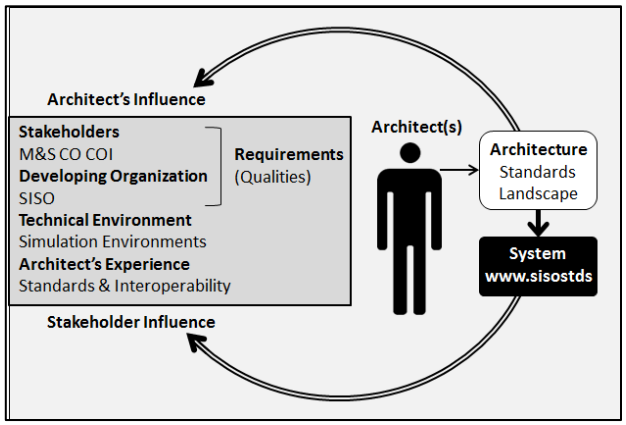

Figure 8. Architecture Business Cycle [14]

The strength of analyzing quality attribute scenarios is that they crosscut all of the stakeholder-specific use cases. Quality attribute scenarios provide the structure integrate the Landscape holistically.

2.5 Plan to Integrate & Test the Landscape

The plan is to integrate and test the standards landscape in the form of a prototype that can be used to acquire feedback from SISO stakeholders. The prototype will help reduce the cost and effort in developing the landscape by (1) enabling early adjustments to the approach, and (2) assessing the value of components (data and views) of the landscape. There are semantic languages that enable SISO to capture the logical structure of the Standards Landscape Taxonomy and associated views. For the prototype the docbook [12] schema can be used to capture the views in a presentation neutral format from which many formats can be generated to include HTML, XHTML, EPUB, PDF, man pages, Web help and HTML Help. In this manner the docbook serves as a prototype of the Standards Landscape Taxonomy Knowledge Base. SISO can generate prototype documents in Adobe PDF as well as prototype HTML pages that can be evaluated and integrated into the www.sisostds.org web pages.

The prototyped documents can present the four views identified in this paper in specific context to stakeholder concerns. The prototype can help the landscape team verify the conceptual integrity, stability, and supportability of the views and associated data.

2.6 Plan to Execute the Landscape

The objectives of executing the landscape are to:

a. **Develop the SLTKB** in the form of docbooks
b. **Integrate & Test the Standards Landscape** views generated in PDF and HTML formats.
c. **Evaluate the Standards Landscape**'s PDF and HTML formats documents.

This plan for the Standards Landscape's integration within sisostds.org is deliberately not specified here as it will depend on the findings produced by the evaluation of the Standards Landscape.

The plan to execute the Standards Landscape is to perform the activities identified in activities/steps 4-7 as identified in Section 2 Technical Approach. The plan for the standards landscape includes a schedule and work breakdown structure of these activities.

2.7 Plan to Assess the Landscape

The plan to assess the Standards Landscape is to evaluate the landscape based on the quality attribute scenarios identified in this paper. In effect this means evaluating the quality provided by the Standards Landscape in context to the selected quality attributes and stakeholder use cases.

An assessment matrix can be developed, grouped by quality attributes (scenario) covering the requirements derived from that scenario's use case. The assessment matrix can be used by SISO stakeholder communities of interest to assess the Standards Landscape in context to:

- SIW meetings with stakeholders formal and informal
- Discussion thread on the Landscape
- SISO LinkedIn page for group discussions

It should be noted that the assessment matrix is not necessarily specific to the Standards Landscape, but could also be used as a general case assessment tool in evaluating stakeholder architectures. This is another example of how the Standards Landscape can assist stakeholders in achieving their ROI.

M&S Community of Interest provides a broad set of stakeholders appropriate to the assessment of the SISO Standards Framework. M&S COI provides for collaboration across the enterprise ref Figure 9. M&S Community of Interest [8]. There appears to be an excellent fit between the need to assess the framework, and the mission of the M&S COI.

Figure 9. M&S Community of Interest [8]

3. Findings

- NMSSP provides a good starting point for (1) aligning SISO standards to the DSEEP and (2) identifying domain gaps in standards (VV&A for example).
- Current work on the Standards Landscape based on spreadsheets has good information, but spreadsheets are not sufficient for capturing the data.
- Gaps in SISO standards exist in layers of Operations, Systems, Data, and Ontology.
- Gaps in SISO standards exist in the integration of M&S with stakeholder life cycles (training, acquisition, military decision making, etc.).
- Opportunities for new standards exist within the emerging domain needs of SISO stakeholders. For example:
  - PMESII and HSCB modeling in context to counterinsurgency and stability operations of the military.
  - Service oriented architecture and cloud computing.
  - Gaming technologies, pay-off functions, etc.
- Existing work on the Standards Landscape crosswalk can be integrated with the NMSSP and M&S CO crosswalk. A draft of a new matrix of SISO products has been complied to include SISO & IEEE standards, reference products, guidance products, and best practices.
- IEEE-SA and ISO utilize very similar methods to cataloging standards. The timeline for developing the Standards Landscape can be reduced if SISO emulates approaches used by these standards organizations.

4. Summary of Recommended Next Steps

- EXCOM and SAC work together to agree on and focus the Plan for the Standards Landscape. Due to the number of standards and standards organizations, SISO needs specific guidance on the scope of the Standards Framework.
  - The current plan has been deliberately specified in detail. The level of effort can and should be trimmed by EXCOM decisions in order to narrow focus and reduce the time needed to produce the Landscape.
- Form a SISO group (the Landscape Team) to implement the Plan for the Standards Landscape. The team should reflect the breadth and depth of SISO.
  - The Landscape Team should include a broad set of expertise to include users, standards developers, architects, and managers.
- Market and sell the concept of a Standards Landscape to SISO groups and stakeholders. SISO members need to understand what the Standards Landscape represents and how it will benefit SISO and their own groups.
  - The prototyped documents can serve to market and solicit feedback from a within and outside of SISO.
- Gain M&S CO's support for developing the Standards Landscape to include M&S COI participation in the assessment of the Standards Landscape. M&S COI is well positioned to assess the value of the Standards Landscape and the improvement on stakeholder ROI that it enables.
  - SISO may want to consider including all of our government and non-government sponsors in the assessment, however M&S CO is of particular importance to SISO's long term vision.

5. Conclusions

There exist a considerable number of standards, guidance, and reference products available to stakeholders from

within SISO and from outside of SISO. Gaps in standards will always exist as stakeholder use cases and requirements evolve new needs for standards will continue to emerge. Unfortunately sufficient documentation on how standards are intended to integrate/interoperate does not exist today. This makes the task of adapting standards to fill the emerging gaps very difficult, potentially leading to unfulfilled needs of our stakeholders and/or development of new standards that, while they may fill an existing gap, also duplicate standards already in use.

The plan for the Standards Landscape provides a starting point to change the way SISO views, presents, and develops standards. It will change the SISO stakeholders view and understand the value of SISO products and how integrated SISO products can collectively enable their ROI. The plan identifies a concept of operation and the necessary data sources to successfully develop the Standards Landscape. However, to succeed SISO will need to integrate group efforts within and outside of SISO to create the Standards Landscape. Just as the landscape is to document how standards interrelate, SISO's landscape development team will need to work with (interrelate) SISO groups and communities of interest in order to succeed.

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Acknowledgments

This work was based on current approaches employed by IEEE-SA, ISO, W3C as successful standards organizations. Approaches utilized can be emulated by SISO as a starting point/strategy for the Standards Landscape.

This work was informed by past efforts of the NATO Modeling & Simulation Profile, and M&S CO's standards crosswalk, and the existing SISO Standards Matrix. This work will greatly reduce SISO's level of effort in creating the Standards Landscape.

The work was organized based on approaches defined in the IEEE Distributed Simulation Engineering and Execution Process, DODAF 2.0, and the SEI text "Software Architectures in Practice". This work provides methods from which to improve and adapt the Standards Landscape.

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